Ocean and Coastal Law Journal

Volume 16 | Number 2 Article 14

2010

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THE RISING SEA. Orrin H. Pilkey & Rob Young. Island Press. 2009.

Picture a gorgeous summer day. A couple sits on a sandy beach with their small child. It is low tide and the sand seems to stretch on for a mile until it reaches the water. Soft, small waves gently lap around a few scattered swimmers as the occasional new shell is exposed for the collector taking a morning walk. The couple has gone to the beach to escape their hectic lives; to relish in the calm of the melodic sea. Now picture this: it's August 29, 2005, New Orleans. Hurricane Katrina is beating down on the coast of Louisiana. Or picture Chatham, Massachusetts, where houses are falling into the sea due to increased coastal erosion. Or picture Baytown, Texas, in 1983, when floods caused by Hurricane Alicia forced an entire community of three hundred homes to be relocated by the Federal Emergency Management Agency (FEMA). These are all results of sea level rise (SLR).

Sea levels are rising around the globe. Whether or not one believes in climate change, historically, sea levels have fluctuated with the shifting of continental ice sheets.[1] With highly developed coastlines, the United States is going to see great economic, environmental, and human impacts as the seas take back coastal land. In *The Rising Sea*, Orrin H. Pilkey[2] and Rob Young,[3] discuss some of the policy and legal challenges of adapting the nation's coasts for SLR. Pilkey and Young do this by

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1. *See generally* Massachusetts v. EPA, 549 U.S. 497 (2007) (in this case, the Court acknowledged climate change and its serious impact); The National Climate Program Act of 1978, Pub. L. No. 95-367, 92 Stat. 601 (1978) (in enacting this law, Congress recognized the significant impacts of climate change).

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describing some of the challenges coastal communities are facing in adapting to SLR and some of the tools that communities are considering or using for adaptation. The book itself is easily digestible and would be a quick read for policy makers, land use planners, and the average coastal dweller alike. The book is written in a liberal tone with an entire chapter (Chapter 5, *A Sea of Denial*) devoted to the "noisy minority"[4] of climate change skeptics; therefore, this book is likely to find its way into the hands of those seeking to remediate the impacts of climate change, not those looking to prove or disprove its existence. *The Rising Sea* gives a very general overview of SLR and strategies for adaptation to SLR, and Pilkey and Young authored the text to give the public "critical but basic facts" about SLR and its impacts.[5] With that in mind, this book successfully executes its goal to create a foundation for the general public to better understand the effects of SLR.

Pilkey and Young briefly describe the science behind SLR, providing unfamiliar readers with a basic overview of relevant statistics.[6] For example, the book cites the United Nations Intergovernmental Panel on Climate Change (IPCC) for the fact that there is a greater than 90 percent probability that humans are accelerating climate change.[7] One of the extremely helpful things that Pilkey and Young do is weave science throughout the text. While the groundwork for scientific understanding is laid in chapter two, the authors repeatedly come back to the IPCC and other reputable journals and reports to frame their SLR examples in sound science.

Some of the most useful information for policy and decision makers in *The Rising Sea* comes towards the end of the book. Pilkey and Young note that the impacts of SLR are far reaching: loss of agricultural and nonagricultural land; flooding; increased vulnerability to storm surges; accelerated erosion of shorelines and artificial beaches; increased salinization of surface and groundwaters; increased flood heights of tidal rivers; loss of biodiversity (loss of marshes/mangroves/coral reefs); loss of aquaculture, fishery, marina infrastructure; and tourism decline as beaches erode and resorts are threatened.[8] Cities are particularly vulnerable, and Pilkey and Young note that major United States cities, such as New York, Boston, and Washington, D.C. are susceptible to:

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4. PILKEY & YOUNG, THE RISING SEA 81 (2009).

5. *Id.* at xii.

6. *See id.* at 25.

7. *Id.* at 36; *see also* IPCC WORKING GROUP I, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 989 (2007).

8. *Id.* at 131-32.

blockage of city storm drainage, sewage treatment facilities and subways; salinization or pollution of domestic water supplies; flooding; increase in the extent and penetration of storm surge; loss of protective barrier islands that rim many coastal plains; infrastructure loss—water, electrical power, railroads, port facilities; and, requirement for dikes, levees, seawalls, and relocation of buildings.[9] For a reader with limited knowledge of SLR, this information is extremely helpful in understanding that the impacts of SLR are more expansive than just a shrinking shore. It highlights that much of the impacts of climate change are interrelated and the term "the rising sea" encompasses more than just additional volume in the oceans.

Pilkey and Young primarily educate the reader by providing examples of SLR and adaptive measures in different coastal communities. While a wise policy maker or community planner will look to other countries for examples of what SLR may do in his community, some of the most poignant examples of SLR impacts that Pilkey and Young provide are in the United States, making it easy for the reader in the United States to analogize to his community. Pilkey and Young use specific examples to illustrate that many of the threats to coastal communities are interconnected. For example, rising sea levels allow storms to remove protective dunes, causing future storms to create damage further inland.[10] In the 1964 Good Friday earthquake, hundreds of miles of Alaskan shoreline south of Anchorage suddenly dropped from one to four feet.[11] *Isle Derniere* (Last Island) in Louisiana was completely destroyed by a hurricane in 1856.[12] Last Island had an average elevation of about five feet and had significant shoreline erosion and SLR.[13] Similarly, Edingsville Beach in South Carolina was destroyed by a series of hurricanes beginning in 1881.[14] The town of Diamond City, North Carolina, began to relocate after an 1899 storm.[15] Pilkey and Young note that flooding, or storm surges, can be some of the most destructive outcomes of larger coastal storms.[16] These examples serve as reminders to the reader that there are more consequences to a rising sea than a shrinking shoreline.

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9. *Id.* at 137.
10. *Id.* at 125.
11. *Id.* at 119.
12. *Id.* at 120.
13. *Id.*
14. *Id.* at 123.
15. *Id.* at 124.
16. *Id.* at 131-32.

Some of the most dramatic examples of SLR and response to SLR demonstrated by Pilkey and Young are found in Alaska.[17] In addition to SLR, the Arctic is now subjected to longer ice-free periods due to a rise in atmospheric and oceanic temperatures.[18] Without the ice barrier, the shoreline is subjected to increased erosion from storms.[19] Additionally, the permafrost under the shoreline bluffs and beaches is melting, causing accelerated erosion.[20] This has become a critical issue in the villages of Kivalina and Shishmaref, where increased sea levels have made the islands almost inhospitable to the communities that have relied on the islands for jobs, food, culture, and homes.[21] After a brief overview of the problems facing Shishmaref, Pilkey and Young walk readers through five alternatives for the island to consider for adaptation: build, maintain, and reinforce seawalls; remain on the island but move homes as they become threatened by erosion; relocate the entire community to a larger city; relocate the entire community to another native village; or move the entire community to the mainland.[22] Ultimately, the community of Shishmaref chose to relocate the entire village to the mainland; at a cost of approximately $180 million to the federal government.[23] Moving Kivalina would cost approximately the same amount.[24] Who pays for this relocation? In 2008, Kivalina sued nine oil companies, fourteen power companies, and one coal company for funds to move the village to the mainland.[25] Kivalina officials argued that the increased temperatures and subsequent SLR was caused by carbon dioxide emitted by the named companies.[26] Pilkey and Young indicate that other communities, such as the Canadian Inupiat Eskimos, are considering lawsuits against Western carbon dioxide producers.[27] This only just hints that litigation due to SLR and climate change is just beginning.[28]

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17. *See id.* at 7-10.
18. *Id.* at 7.
19. *Id.*
20. *Id.*
21. *Id.*
22. *Id.* at 11-14.
23. *Id.* at 14.
24. *Id.*
25. *Id.*
26. *Id.* at 14.
27. *Id.* at 20.
28. *See, e.g.,* Massachusetts v. EPA, 549 U.S. 497 (2007); Stop the Beach Renourishment v. Florida Dept. of Envtl. Prot., 130 S. Ct. 2592 (2010) (where the Court determined that the state's legislation to restore storm-eroded beaches along the ocean, modifying the private property boundary line, did not constitute a taking); American Electric Power Co. v. Connecticut, 582 F.3d 309, *appeal docketed*, No. 10-174 (Dec. 6

At first glance it may seem like the villages of Shishmaref and Kivalina are unique in both their problems and their solutions; they are remote villages deeply grounded in culture. However, as the seas continue to rise, the issues faced by these two villages are becoming more common, and the unique communities that cover coastal United States will be increasingly threatened. Although New Orleans is below sea level, after Hurricane Katrina many homeowners preferred to rebuild their homes and communities rather than relocate.[29] This theme of communities resisting relocation is present throughout the book. For example, the book mentions that in Camp Ellis, Maine, the United States Government offered to buy threatened beachfront houses at their full value, but homeowners refused to sell.[30] If retreating from the coastal land is the only viable solution to SLR, as the authors suggest, policy and decision makers will need to know the potential challenges and possible solutions to those challenges. There are places where the book briefly touches on, but does not fully explore, topics that would be of great interest to policy and decision makers. What are some of the ways that communities can be encouraged to relocate? The book leaves readers to ponder this question on their own.

While relocation may be a viable solution for some villages, remote villages are not the only places that are seeing great SLR. Pilkey and Young note that one of the most dramatic places of SLR is Venice.[31] In the last century Venice has seen a ten inch rise in sea level, causing increased flooding from ocean storms.[32] The population of Venice declined from 121,000 in 1996 to 62,000 in 2009, and continues to drop.[33] What happens with a city too large to relocate? Pilkey and Young note that cities in the United States such as Boston, Manhattan, Charleston, Miami, and Galveston are poised to find out.[34]

One of the most useful things the book successfully achieves is providing a historical picture of SLR impacts on coastal development. This is done throughout the text and reminds the reader that SLR effects

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2010) (currently before the Court is American Electric Power Co. v. Connecticut, examining whether states can use public nuisance laws to force coal-burning power plants to reduce their emissions).

29. *See New Orleans' Deep Roots Bolstered Katrina recovery*, PBS NEWSHOUR (April 18, 2011), http://www.pbs.org/newshour/bb/weather/july-dec10/photoessay_08-23.html.

30. PILKEY & YOUNG, *supra* note 4, at 160.

31. *Id.* at 21.

32. *Id.* at 22.

33. *Id.*

34. *Id.* at 24.

have been impacting civilization as long as civilization has existed. Most interestingly, the authors note that instantaneous SLR caused by earthquakes has reclaimed numerous cities back to the sea. Pillars and statues submerged underwater suggest that the Mediterranean cities of Menouthis, Herakleion, and Alexandria were likely engulfed by the sea during an earthquake.[35] In 1692 the city of Port Royal, Jamaica, was submerged due to an earthquake.[36] In Colombia, the Great Tumaco Earthquake and resulting tsunami killed almost all of the residents of the remote fishing village of San Juan de la Costa.[37] What was not destroyed in the earthquake and tsunami was reclaimed by the sea within a few years due to increased erosion on the newly lowered land.[38] These examples serve as a reminder to readers that even long-established cities are capable of being consumed by the sea. A reader picking up *The Rising Sea* today will be very familiar with the devastation an earthquake and tsunami can have on the coast following the March 11, 2011 earthquake and resulting tsunami on the east coast of Japan.[39] Sometimes, all it takes is one large earthquake to destroy hundreds of years of city development.

How can communities, cities, and nations predict the (seemingly) unpredictable? In the third chapter of the book, Pilkey and Young discuss the various ways that communities, states, and nations have been trying to predict SLR.[40] Some of them have been successful, others have not. The authors note that using mathematical modeling (both qualitative and quantitative) alone is flawed because it does not take into account human action.[41] Often, the authors point out, the most unpredictable element of the prediction equation is human behavior.[42] For example, in 1999 when Hurricane Floyd passed by Charleston, South Carolina, the governor overruled emergency management officials and kept inbound highway lanes on Interstate 26 open; in all emergency plans, both outbound and inbound lanes were designated outbound evacuation

35. *Id.* at 119.

36. PILKEY & YOUNG, *supra* note 4, at 119.

37. *Id.*

38. *Id.*

39. *See Earth Quake Summary*, USGS SCIENCE FOR A CHANGING WORLD (April 18, 2011), http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/usc0001xgp.php#summary. In addition to human casualties and loss of infrastructure, the 2011 Tōhoku earthquake caused a nuclear accident at the Fukushima Daiichi Nuclear Power Station.

40. PILKEY & YOUNG, *supra* note 4, at 41.

41. *Id.* at 44.

42. *Id.*

traffic.[43] Pilkey and Young suggest that planners must use a combination of qualitative and quantitative models, field observations, and studies of the past behavior of ice sheets to determine SLR estimates.[44]

As the book is intended to provide an introduction to SLR issues, it only briefly discusses specific laws and policies related to adaptation. An interested policy or decision maker would likely further explore some of the proposed legislation mentioned in the book. For example, the North Carolina legislature considered adopting a real estate disclosure law that would require sellers to fully disclose the nature and magnitude of natural hazards that could affect a property.[45] The proposed legislation came after an out-of-state couple purchased a home on land that had been previously condemned for habitation.[46] Similarly, the book only touches on plans for adaptation that coastal communities or states already have in place or are contemplating.[47] A likely next step for policy and decision makers seeking further education on SLR would be exploring plans that coastal communities and states have developed and implemented for climate change adaptation.[48]

What *can* policy and decision makers do to adapt to the rising sea? Pilkey and Young suggest that there are three ways that communities can deal with the rising sea: abandon beachfront property and relocate infrastructure and communities further inland; armor the shoreline with structures such as seawalls and groins; or renourish beaches with new sand.[49] The authors argue that both the second and third choices are costly and temporary.[50] While the first choice is also costly, it is the only

43. *Id.* at 44-45.

44. *Id.* at 48.

45. *Id.* at 43.

46. *Id.* at 42.

47. *Id.* at 148*; see also* LA. COASTAL WETLANDS CONSERVATION AND RESTORATION TASK FORCE, COAST 2050: TOWARDS A SUSTAINABLE COASTAL LOUISIANA (1998).

48. *See* COASTAL STATES ORGANIZATION, THE ROLE OF COASTAL ZONE MANAGEMENT PROGRAMS IN ADAPTATION TO CLIMATE CHANGE: SECOND ANNUAL REPORT OF THE COASTAL STATES ORGANIZATION'S CLIMATE CHANGE WORK GROUP (2008), *available at* http://www.coastalstates.org/wp-content/uploads/2010/07/CSO-2008-Climate-Change-Report2.pdf; *see also* NAT'L OCEANIC AND ATMOSPHERIC ADMIN., ADAPTING TO CLIMATE CHANGE: A PLANNING GUIDE FOR STATE COASTAL MANAGER (2010), *available at* http://coastalmanagement.noaa.gov/climate/docs/adaptationguide.pdf; *State and Local Adaptation Plans,* GEORGETOWN CLIMATE CENTER, http://www.georgetownclimate.org/adaptation/adaptation-plans.php (last visited May 25, 2011).

49. PILKEY & YOUNG, *supra* note 4, at 159.

50. *Id.*

one that provides a more permanent solution.[51] Again, these three options provide a good foundation for the reader with limited experience with SLR issues. While broadly these three options can encompass many SLR adaptation tools, there is no mention of many of the specific ways that some coastal communities and states are contemplating adapting to SLR, such as conservation easements, development setbacks, tax incentives, and transferrable development credits.[52] The next step for an interested reader would be exploring some of the creative ways coastal communities are beginning to adapt to SLR.

51. *Id.* at 159-60.

52. Conservation easements create an agreement between the landowner and government agency preserving land for conservation purposes and restricting development; development setbacks require new building structures to be located from a specific boundary line determined by the government agency; tax incentives can include tax credits and abatements to encourage preferred future development; transferrable development credits restrict development in one area determined to be unsuitable for development ("sending area") and encourage it in areas more fit for use ("receiving area"). *See supra* note 48.